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(दूसरा पुनरीक्षण)

Guide to Storage of Onions

(Second Revision)

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भारतीय मानक ब्यूरो
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November 2021 **Price Group 4**

Fruits, Vegetables and Allied Products Sectional Committee, FAD 10

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Fruits, Vegetables and Allied Products Sectional Committee had been approved by the Food and Agriculture Division Council.

To ensure fuller utilization of perishable foodstuffs such as fruits and vegetables, they should be preserved under conditions which will keep them fit for fresh consumption over a reasonable period. Storing them in refrigerated space (cold storage) is an important method of preservation. To provide guidelines for the cold storage industry in the country, a series of Indian Standard Guides, based on the corresponding ISO Standards, have been issued. These guides describe the pre-storage treatments and the optimum storage conditions for different fruits and vegetables to help the industry to develop on scientific lines and also to promote the export of fresh fruits and vegetables.

This standard was first published in 1979, for which assistance had been drawn from the then ISO Draft International Standard on the subject. The first revision of this standard was brought out in 2001 to align it with the latest edition of the ISO 1673.

In this second revision, the modifications have been made keeping in view the technological advancements in the area of storage of fresh fruits and vegetables and the practices prevailing in the Indian conditions.

This Indian Standard provides guidance on storage of onions, however, because of the variability of the product according to the time and place of cultivation, local conditions may make it necessary to define other conditions for harvesting or other physical conditions in the store.

Considerable assistance has been derived from the work carried out by National Agricultural Cooperative Marketing Federation of India Ltd. (NAFED) and Bhabha Atomic Research Centre (BARC), India in this standard.

The application of the guidelines contained in this Indian Standard should enable much wastage in storage to be avoided and thus should enable long-term storage to be achieved in most cases.

The composition of the Committee responsible for the formulation of this standard is given at Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’.

Indian Standard

GUIDE TO STORAGE OF ONIONS

(Second Revision)

1 SCOPE

This standard gives recommendations for the storage, with or without the use of artificial refrigeration, of onions of the species *Allium cepa* intended for long-term conservation and consumption in the fresh state.

2 TERMINOLOGY

2.1 Gray — Gray (Gy) is the unit of absorbed radiation dose. 1 Gy is equal to 1 Joule of energy/kg of material being irradiated.

2.2 D min — It is the minimum absorbed dose received by the food samples when subjected to radiation treatment.

3 CONDITIONS OF HARVESTING AND PUTTINGINTO STORE

3.1 Cultivars

It is necessary to choose onions cultivars suitable for long storage. Varieties having medium bulb size with higher dry matter/total soluble solids content, higher pungency, less or no splits and thinner necks with retention of higher number of dry outer scales have better keeping quality with lower storage losses.

NOTE — Onions of late cultivars are generally chosen.

3.2 Harvesting

As onions mature, their dry matter content and pungency increase, with a resulting increase in storage potential. Onion bulbs should be harvested one week after 50 percent of plants have shown neck fall. By this time the bulbs are covered with well-differentiated outer scales signifying that they are in a state of physiological rest**.** Early harvesting would result in more sprouting during storage**.** Whereas delayed harvesting may result in reduction of skin quality, increased rooting and reduction in firmness. Harvesting of onions should be carried out when the weather is dry; harvesting after a rainfall, or when the humidity is high increases susceptibility to post-harvest disease.

Plants should be pulled out along with bulbs either manually or mechanically (using onion diggers) in such a way that they are neither bruised nor otherwise damaged. Improper handling of onion bulbs during or after harvest causing mechanical injuries can severely affect their quality as well as their storage life.

3.3 Quality characteristics

Qualitative inspection of onions intended for storage is strongly recommended. It is necessary to choose onion bulbs of good quality, meeting the following requirements:

a) Sound, free from cuts, bruises and mechanical injuries. Bruising of bulbs causes increase in respiration rate, thereby increasing the weight loss and may encourage entry of pathogens leading to rotting.
b) Mature, well covered by outer scales. Naked onions with exposed fleshy leaves cannot be stored longer and their shelf life is very short.
c) Well dried, and homogeneous.
d) Bulbs which are not covered by outer scales, which are double, triple, too large or too small, deformed, or not fully mature, should not be stored.
e) It is recommended to store only good grade onions without any defects.
f) Some of the storage diseases of onions are given at Annex A (for information only).

3.4 Various Treatments Before Storage

To avoid sprouting, approved sprout inhibitors may be used if their use is not restricted. Onion bulbs should be adequately dried/ cured before storage.

3.4.1 *Curing of Onions*

Before storage, the onions should be dried to eliminate excess external moisture and moisture in the outer scales, the rootlets and the neck (Fig. 1). The process is called curing. It takes around two to three weeks.

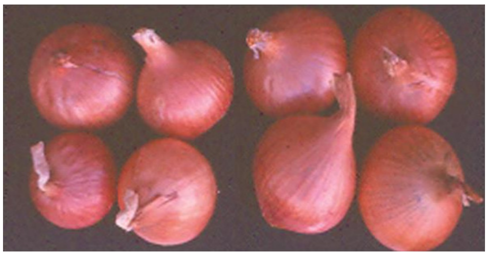

FIG. 1 ONIONS AFTER PROPER CURING

3.4.1.1 *Natural drying*

Onion bulbs should be adequately cured in the field by keeping the harvested/pulled plants in rows along with leaves which partially cover the bulbs preventing direct exposure to sunlight and injury (that is, sunscald) to the bulbs. The bulbs are considered cured when the neck becomes tight and the outer scales are dried until they rustle. This condition would be obtained (in about 3 to 4 days in field) when the bulbs have lost about 5 per cent of their weight. After curing, the tops are to be cut and removed by leaving about 2 to 3 cm length dry neck. If the tops are cut closer to bulbs without keeping 2 to 3 cm neck length, there is possibility of pathogens entering into the bulb and cause rotting. These bulbs should be kept under shade for 2 to 3 weeks for proper drying of bulbs. If not properly cured, the bulbs will decay in storage mainly due to neckrot.

Onions can also be cured in shade or by artificial means by forced ventilation. Shade curing normally takes about 15 to 20 days and is done in well ventilated curing sheds. A properly cured onion has a dried, shrunken neck and dry outer scales without punctures or splits.

3.4.1.2 *Artificial drying*

If natural drying is not possible, a suitable method of artificial drying should be used, for example exposure to a current of warm dry air for a period of 4 days up to a maximum of 8 days, depending on the moisture content. The air temperature may be up to a maximum of 30°C and the relative humidity should, if possible, be from 65 percent to 70 percent. The rate of air flow may be from 2.0 to 2.5 m^3/min per cubic meter of bulbs. Ventilation should be effected either with fresh air from outside the store or with a mixture of outside and inside air, with different rates of air change for the two different types of ventilation. Alternatively, the internal air may simply be recalculated in closed circuit, in which case the recommended air circulation ratio is from 40 to 50 per hour.

Proper drying is achieved when the moisture content of the outer scales reaches 12 percent to 14 percent. At this moisture content, bulbs rustle when handled. Artificial drying should be carried out directly after harvesting, while the onions are in a state of physiological rest, because subsequent treatment with warm air (up to 30 °C) promotes sprouting.

3.4.2 *Irradiation*

Post-harvest treatment with gamma irradiation is successful in reducing storage losses in onion. The application of low doses of radiation can arrest sprouting of onions during storage. Application of irradiation of the order of 60 Gy to 100 Gy for control of sprouting and extension of shelf life of onion is recommended. These radiation doses are within the window of approved dose range for Bulbs (Class 1) as per the Food Safety and Standards Rules and Regulations.

The irradiated onion bulbs are reported to be superior in quality with respect to internal and external appearance and firmness after 180 days storage than non-irradiated ones.

3.5 Storage

Quality of onion during storage is affected due to water loss, sprouting, rooting, and changes in chemical composition. In general, the storage losses due to physiological loss of weight are higher during the months of May to July when mean temperatures are high. The rotting losses are high in the high humid months of rainy season and the sprouting of onion starts in September-October when the temperature starts decreasing.

Stores for keeping onions should be refrigerated or provided with an air-ventilation system with distribution of air through the floor, and should be perfectly dry, clean and disinfected. The onions should be put into store as soon as possible after drying and filling of stores should be carried out quickly, without exceeding a period of 7 days to 8 days. It is necessary to avoid storage of onions with other vegetables or fruits to which their particular taste and odour may be transmitted. Storage of onions and garlic in the same store is, however, permissible.

3.6 Methods of Storage

The onions may be stored in bulk, in packages on pallets, in box pallets, in crates, in sacks or in containers. Onions packed in sacks may be stored for only a short period of time.

In the case of storage in bulk, the maximum depth to which onion can be heaped is between 0.9 to 1.5 meters. Higher depth of bulk storage causes excessive damage from pressure impact/bruising. Onion should not be dropped on ground from higher than 1 to 2 meters which would damage the bulbs.

In case of packed onions, to avoid damage, packages should be stacked 5 to 7 tiers high, and a gap of 15 cm to 20 cm in the proximity of the side walls and 5 cm to 8 cm between the stacks of packages should be provided to ensure the free circulation of air.

For long term storage of onions, proper ventilation, optimum temperature and humidity are of paramount importance. Absence of proper aeration/ventilation, high atmospheric humidity (75-80 percent RH) promotes development of pathogen/rotting, and promotes root growth. Low humidity (less than 65 percent RH) leads to excessive moisture loss from bulbs, resulting in shriveling and loss in weight.

3.6.1 *Natural Ventilated Structures*

Various simple storage structures of onions have been designed traditionally and modified according to the local material available for their construction. Different types of structures like ‘Bottom ventilated storage structures’ and ‘Top ventilated storage structures’ are used for the storage of onion. In India, especially in Maharashtra, onions are bulk stored in storage structures called “chawls” (Fig. 3) with thatched roofs and sides of bamboo which are suitably well spaced to allow good air circulation. These structures were further improved by designing two tier system and also by providing better bottom ventilation, to reduce the losses and extend storage life.

Several modified onion storage structures have been designed and tested by NRC for Onion and Garlic, Pune and NAFED. These structures help in reduction of storage losses.

3.6.1.1 *Salient features of improved storage structures (Fig. 2)*

a) Construction of structure on raised platform to prevent moisture contact and dampness;

b) Use of Mangalore tiled roof or other suitable material to prevent built up of high temperature inside;

c) Increased centre height and more slope for better air circulation and preventing humid microclimate inside godown;

d) Providing bottom ventilation for free and faster air circulation to avoid formation of hot and humid pockets between the onion layers;

e) Avoid direct sunlight on onion bulbs to reduce sunscald, fading of colour and quality deterioration;

f) Restriction on width of each stack to 60-75 cm for hot and humid weather, 75-90 cm for mild and humid weather and 90-120 cm for mild and dry weather conditions;

g) Maintenance of stacking height to 100 cm for small and multiplier onion and hot weather and 120 cm for mild weather and for big onion to avoid pressure bruising';

h) Providing cubicles instead of continuous stack and sufficient space for ventilation from all sides;

j) The practice of turning may be followed during storage when onions are packed in sacks;

k) One cub meter area of store accommodates about 750 kg onion. Accordingly, construction of godown for required capacity and construction of more units instead of single big structure and in zig-zag manner when constructed in more rows;

m) Providing two tier if space available is insufficient; and

n) Periodical disinfections of structures and premises to check rotting.

3.6.2 *Cold Storage*

A temperature of 0.2 °C to 1 °C and relative humidity of 65 percent to 70 percent is recommended for cold storages of onion. The bulbs to be held in cold storage should be placed there immediately after curing. For storage of properly cured onions, maintenance of the recommended temperature and relative humidity are very important for the successful cold storage of onion. It is essential that the refrigeration system of cold storage should be efficient enough to pull down the produce temperature to less than 5 °C within 24 h once the onions are kept for storage. To obtain constant temperature and relative humidity, it is necessary to set very strict requirements for the air-circulation as well as dehumidification systems.

3.6.2.1 *Operation during removal from cold storage*

The onions should not be handled if they exhibit crystals of ice. Precautions should also be taken to avoid any risk of *freezing* of super cooled onions during handling.

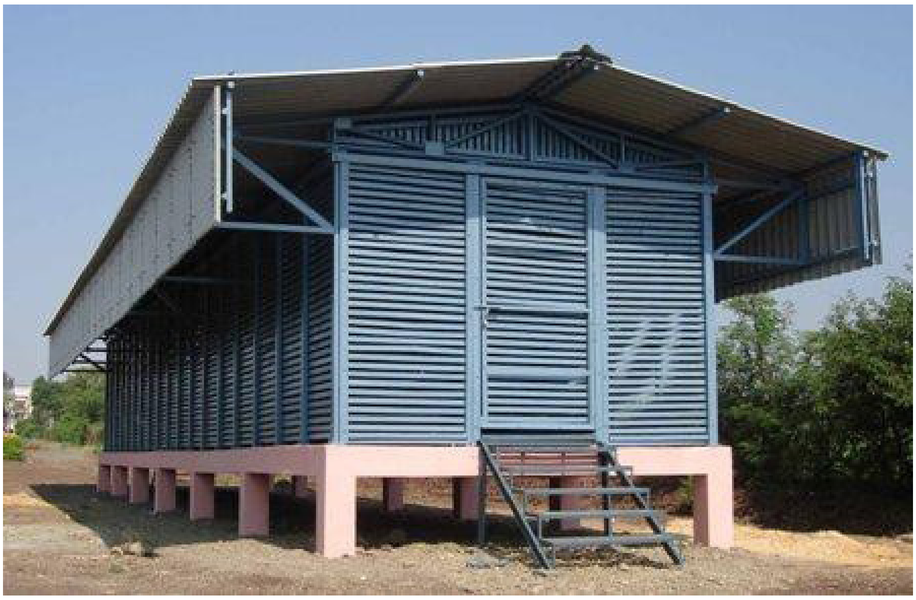

FIG. 2 IMPROVED VENTILATED ONION STORAGE STRUCTURE

To avoid all traces of moisture on the surface of the bulbs, when the onions are taken out of storage, it is recommended that the onions must be brought to ambient temperature by gradually increasing the store temperature in a reheating room in order to avoid condensation of onions that lead to mould growth and root development. Then conditioning and packaging of onions for delivery may proceed. Care is also to be taken to avoid skin becoming brittle because of long exposure to low relative humidity.

The temperature and humidity conditions should be maintained constant throughout the storage period. The maximum allowable variations in temperature and relative humidity are ± 0.5 °C and ± 2 prcent respectively. Quality control of onions should be carried out every 7 days to 10 days to verify the sanitary and behavioral state of the produce**.**

In India, cold stores are not used for storage of onion for fresh marketing and are used only for processing purposes by some industries.

3.6.3 *Controlled Atmosphere (CA) Storage*

In this storage system there will be elevated levels of carbon dioxide and reduced levels of oxygen maintained continuously throughout the storage in addition to the recommended low temperature. This type of storage (now commercially being used in apples) is reported to increase storage life not only for cultivars with high storage potential, but also for cultivars with low storage potential kept under regular atmospheres. The recommended CA storage conditions includes 5 percent carbon dioxide, 2 to 3 percent oxygen and 92 percent nitrogen at 1°C with a storage life of at least 7 months with maintenance of quality and shelf-life when removed from the CA storage. However, response to CA storage varies among onion cultivars.

3.6.3.1 *General conditions for CA storage of onion*

a) CA storage rooms must be air-tight and moisture-tight;

b) CA gas concentrations: 5 percent CO_2 and 2 to 3 percent O_2, the rest being N_2;

c) Storage temperature should be 1°C ± 0.5 and 65-70 percent RH;

d) Storage air circulation should be at 100-200 cfm/ton of onions;

e) Control system to monitor temperature, humidity and gas atmosphere inside the CA rooms without entering them; and

f) Onions must be brought to ambient temperature by gradually increasing the store temperature before removal from CA storage to prevent moisture condensation and to reduce incidence of sprouting.

4 SUMMARY OF RECOMMENDED STORAGE CONDITIONS

The technological phases and their duration, and the corresponding conditions that should be effected, are indicated in Table 1.

Table 1 Summary of Storage Condition for Onions

(*Clause* 4)

Technological Phase		Duration	Temperature °C	Relative Humidity *Max.* Percent	Ventilation Rate h/Day
Natural drying		Up to 2-3 weeks	External air	65 to 70	18 to 20
Artificial drying		4-8 days	Warm air (30 °C max)	65 to 70	18 to 20
Storage	under ambient condition	3-4 months	Ambient air	65 to 70	6 to 8
	under artificial refrigeration	5-6 months	0.2 to 1 (– 1 °C)*	65 to 70	6 to 8

*For cultivars having resistance to cold.

ANNEX A

(*Informative*)

STORAGE DISEASES

A-1 NECK ROT

Neck rot is the most common storage disease. The symptom appears as water- decay at neck area, which moves down word through entire bulb. Light gray fungal growth is generally visible at neck infection and on outer scales. Seed treatment before planting, proper drying and curing of onion are essential to prevent this storage disease.

A-2 BLACK MOULD

Characterized by black discoloration at neck caused by the fungus *Aspergillus niger*. The black discolouration can also be found on the outer scales. This is often associated with bruising and leads to bacterial soft rot. Low temperature storage delays growth of fungus, but it is high under high temperature and high humid conditions. Proper curing reduces infection.

A-3 BACTERIAL ROTS

Several types of bacterial diseases have been reported to affect the onions in storage. Among them, slippery skin and sour skin are common. Water-soaked, foul smelling, viscous liquidly rot is caused by *Erwinia.* The slippery skin is generally visible only at neck area and upon cutting to expose inner scales. Scales have a watery-cooked appearance. In Sour skin, slimy, yellow-brown decay generally limited to inner scales, which give off a sour odour when exposed.

These diseases can be controlled by pre-harvest fungicidal sprays, harvesting at proper maturity, minimizing bruises, effective curing and proper sanitation.

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Fruits, Vegetables, and Allied Products Sectional Committee, FAD 10

Organization	*Representative(s)*
ICAR-Indian Institute of Horticultural Research, Bengaluru	Dr M. R. Dinesh (***Chairman***)
All India Food Processors Association, New Delhi	Dr R. K. Bansal Shrimati Mamta Arora (*Alternate*)
Association of Food Scientists and Technologists India, Mumbai	Dr Revathy Baskaran Dr K. V. Harish Prashanth (*Alternate*)
CSIR-Central Food Technological Research Institute, Mysore	Dr P. Vijayanand Dr A. S. Chauhan (*Alternate*)
College of Agricultural Engineering Post-Harvest Technology, Gangtok	Dr Sujata Jena Dr Said Prashant Pandharinath (*Alternate*)
Confederation of Indian Food Trade and Industry, New Delhi	Shrimati Priyanka Sharma
Consumer Guidance Society of India, Mumbai	Dr Sitaram Dixit Dr M. S. Kamath (*Alternate*)
Dabur Research and Development Centre, Ghaziabad	Shri Dinesh C. Pandey Shri Sumit Nara (*Alternate*)
Defence Food Research Laboratory, Mysore	Dr O. P. Chouhan Dr A. Jagannath(*Alternate*)
Export Inspection Council of India, New Delhi	Shri Parmod Siwach
ICAR-Central Institute of Agricultural Engineering, Bhopal	Dr C. R. Mehta Dr M. K. Tripathi (*Alternate*)
ICAR-Indian Institute of Horticultural Research, Bengaluru	Dr R. B. Tiwari Dr D. V. Sudhakar Rao (*Alternate*)
ICAR-Central Institute for Subtropical Horticulture, Lucknow	Dr Neelima Garg
ICAR-Central Institute of Post-Harvest Engineering and Technology, Ludhiana	Dr Ramesh Kumar Dr Sunil Kumar (*Alternate*)
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Member Secretary

Shrimati Varsha Gupta
Scientist 'D' (FAD), BIS

Panel Responsible for Review of Indian Standards Related to Storage, Transport and Ripening of Fresh Fruits and Vegetables, FAD 10 : Panel 2

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Bhabha Atomic Research Centre, Mumbai	Dr Satyendra Gautam
ICAR-Indian Institute of Horticulture Research, Bengaluru	Dr D. V. Sudhakar Rao
ICAR-Central Institute for Subtropical Horticulture, Lucknow	Dr Bharati Killadi
Warehousing Development and Regulatory Authority, New Delhi	Shri Vinay Kumar Chauhan

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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